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(54) Title: RECHARGEABLE ELECTROCHEMICAL CELL

(57) Abstract: An electrochemical cell is provided, including an anode, a cathode, and an electrolyte therebetween. The anode contains magnesium in a reduced state, and the cathode includes a rutile structure. The rutile structure is capable of intercalating magnesium ions received from the anode to produce a low voltage. The electrochemical cell is rechargeable. Additionally, the electrochemical cell is cheaper, more environmentally friendly and has a higher volume density than related art electrochemical cells. A method of manufacture is also provided.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01M10/40 H01M4/02 C01G23/047

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01M C01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NOVAK P. ET AL.: "Magnesium insertion electrodes for rechargeable nonaqueous batteries" ELECTROCHIMICA ACTA, vol. 45, 1999, pages 352-367, XP002153767 ISSN: 0013-4686 the whole document	1-72
A	NOVAK P. ET AL.: "Electrochemical insertion of Magnesium in metal oxides and sulfides from aprotic electrolytes" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, vol. 140, no. 1, 1993, pages 140-144, XP000548047 ISSN: 0013-4651 the whole document	1-72
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GREGORY T. D. ET AL.: "Nonaqueous electrochemistry of Magnesium - Applications to energy storage" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, vol. 137, no. 3, 1 March 1990 (1990-03-01), pages 775-780, XP000237613 ISSN: 0013-4651 the whole document	1-72
A	US 4 894 302 A (THE DOW CHEMICAL COMPANY) 16 January 1990 (1990-01-16) Col. 3, line 42 - Col. 4, line 4; Col. 4, line 64 - Col. 5, line 44; Col. 5, line 52 - Col. 6, line 2; Fig. 1; Claim 1	1-72
A	WO 01/09972 A (UNIVERSITA' DEGLI STUDI DI PADOVA) 8 February 2001 (2001-02-08) P. 4, line 18 - P. 5, line 10; P. 6, line 11 - P. 8, line 19; Claims 1-4, 8-14, 17-23 & 29	1-72
A	WO 01/29919 A (BAR-ILAN UNIVERSITY) 26 April 2001 (2001-04-26) P. 6, line 13 - P. 7, line 13; P. 9, line 1 - P. 10, line 8; P. 10, lines 25-29; Claims 1 & 9	1-72
A	US 4 198 476 A (BELL TELEPHONE LABORATORIES INC.) 15 April 1980 (1980-04-15) Col. 1, line 66 - Col. 2, line 16; Col. 2, lines 42-52, Fig. 1; Claim 1	1-72
A	US 5 464 708 A (UNITED KINGDOM ATOMIC ENERGY AUTHORITY) 7 November 1995 (1995-11-07) Col. 1, lines 23-39; Claim 1	1-72

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP 03/13789

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4894302	A	16-01-1990	NONE	
WO 0109972	A	08-02-2001	IT PD990179 A1	29-01-2001
			AU 6278000 A	19-02-2001
			CA 2380509 A1	08-02-2001
			CN 1365524 T	21-08-2002
			WO 0109972 A1	08-02-2001
			EP 1205003 A1	15-05-2002
			JP 2003506832 T	18-02-2003
WO 0129919	A	26-04-2001	US 6316141 B1	13-11-2001
			AU 1209401 A	30-04-2001
			BR 0015052 A	24-09-2002
			CA 2387863 A1	26-04-2001
			CN 1391706 T	15-01-2003
			EP 1245053 A1	02-10-2002
			JP 2003512704 T	02-04-2003
			WO 0129919 A1	26-04-2001
			US 2001049060 A1	06-12-2001
US 4198476	A	15-04-1980	BE 878614 A1	31-12-1979
			CA 1137162 A1	07-12-1982
			DE 2935617 A1	20-03-1980
			FR 2435824 A1	04-04-1980
			GB 2030352 A ,B	02-04-1980
			JP 1456807 C	09-09-1988
			JP 55037797 A	15-03-1980
			JP 63000901 B	09-01-1988
			NL 7906722 A ,B,	11-03-1980
			SE 446917 B	13-10-1986
			SE 7907151 A	09-03-1980
US 5464708	A	07-11-1995	AU 2648192 A	21-05-1993
			DE 69210036 D1	23-05-1996
			DE 69210036 T2	05-09-1996
			DK 608278 T3	13-05-1996
			EP 0608278 A1	03-08-1994
			WO 9308612 A1	29-04-1993
			GB 2274195 A ,B	13-07-1994
			JP 3234225 B2	04-12-2001
			JP 7500220 T	05-01-1995
			KR 263103 B1	01-08-2000